

# Nutrition of Infants and Preschool Children in Ethiopia

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During the nutrition survey in Ethiopia (1) several procedures were used to collect information on the nutritional status of infants and preschool children. The nutrition team with the assistance of Ethiopian health officers filled out questionnaires concerning the dietary patterns of infants and children attending the outpatient clinics of three hospitals in Addis Ababa and children at the police training base in Asmara. The questionnaire also contained information on the general health of the infants and some health practices of the people.

Capillary blood samples from about two-thirds of this group and from both preschool and school-age children examined during the latter half of the survey were analyzed for serum proteins, ascorbic acid, and alkaline phosphatase after being shipped to Cairo in the frozen state. The data on growth patterns in infancy, compiled by Dr. Otto Jäger of the public health school at Gondar, are included in this report. The other growth data were collected

by the survey team wherever preschool children were examined. The clinical findings for infancy are general impressions based on our own observations and discussions with many physicians throughout the country. Tabulated clinical findings for those preschool children who were examined during the general survey are included.

## Dietary Patterns

Nutrient intake records were obtained in Addis Ababa by questionnaire by two health officers and one sanitarian. These workers interviewed the mothers of 34 children at the Mahatma Ghandi Memorial Hospital, of 41 children at St. Paul's Hospital, of 35 children at the Ethiopian-Swedish Pediatric Clinic, of 13 children at the police training base in Asmara, and of 10 children seen during the course of the survey. The selected nature of this sample is to be emphasized, but it provides information of interest.

The mother's age and number of children were recorded. Although the number of children reported usually refers to the number of living children, it is taken as roughly indicative of the mother's parity. The mothers ranged in age from 16 to 49 years at the time they were interviewed. The median maternal age was 27 years. Their median age by number of children was as follows.

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<i>Number of children</i>	<i>Median age of mother (years)</i>
1 -----	22
2 -----	24
3 -----	28
4 -----	31
5 -----	32
6 -----	32
More than 6 -----	35

The median number of children per family was three. Families with more than four constituted only 8 percent of this sample. The age, number of children, and breast-feeding status of the children whose mothers were interviewed follow.

<i>Age of child (months)</i>	<i>Number</i>	<i>Percent breast fed</i>
Less than 3 -----	15	82
3-5 -----	14	77
6-11 -----	26	72
12-17 -----	19	54
18-23 -----	20	40
24-35 -----	16	13
36-59 -----	23	9
Total -----	133	

Fifty-one percent of these children were boys.

Nearly three-quarters of the infants were breast fed for at least 1 year, and more than half for 18 months. That 18 percent of these infants were not breast fed to 3 months may reflect the selected sample obtained in the urban clinics.

Information was recorded concerning the

reason for discontinuing breast feeding of 36 infants. The reasons given were: 10 mothers stopped because of an ensuing pregnancy, 6 because of illness, 5 had not established successful lactation, 5 had inadequate milk, 3 interdicted nursing because of maternal tuberculosis, 2 because they were employed outside the home, 2 because the infants were ill, 1 infant was adopted at the age of 6 months, 1 mother had died, and 1 mother stopped nursing "on medical advice."

Supplements to breast feeding consisted of three types of foods: some modification of cow's milk; sugar, cereal, and tea; and foods from the family diet. By the age of 6 months 86 percent of the 133 infants were receiving cow's milk in some form. This often consisted of very small amounts (2 or 3 tablespoonfuls) of powdered milk greatly diluted and fed from a bottle. On the other hand, as much as 1 liter of fresh or evaporated cow's milk was sometimes given to a child. During the second year of life the milk supplement had decreased and, in the 3- to 5-year age group, less than two-thirds of the children were receiving milk in any form, and many of these received but a small amount. Again, the relatively frequent use of milk as a supplement in the first year of life may reflect the special nature of the group sampled at these clinics.

In the 6- to 11-month age group, 4 to 26 infants had milk fortified with cereal and 3 were



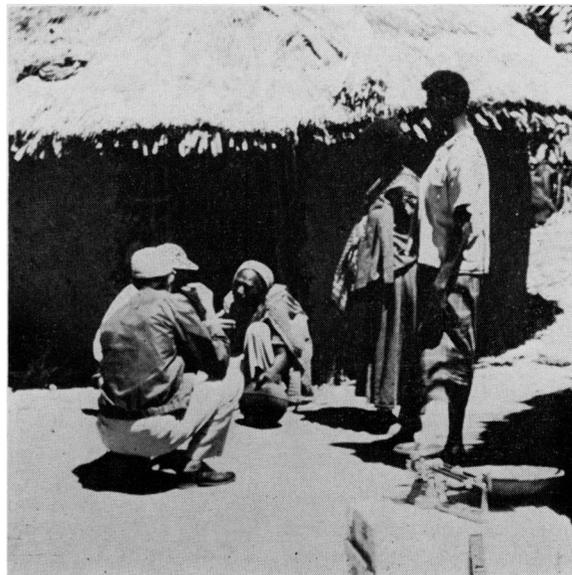
Children at Mulu Farm wait for physical examinations

receiving bread, injera (a sourdough pancake made from teff, a local grain similar to wheat), or potato. Two infants in this age group received eggs "frequently." During the second year of life 23 of 39 infants were being fed injera, wat (a hot, highly seasoned stew or thick soup, commonly containing ground red pepper, garlic, onions, butter or oil, potatoes, pulses, and occasionally meat), and bread, and only a very few children received any fruit or eggs. About one-fifth of the infants received nothing but milk even after the age of 2 years, half of these being fed it in the fresh form. The others received only those foods provided by the family diet.

Only one-third of the infants under 1 year of age received boiled water. This is more than one would expect throughout the country as a whole. Only 12 of the 133 infants received vitamins at any time, and of these the majority received vitamin A and D capsules for a limited period. An attempt was made to collect estimates of exposure to sunlight, but this proved unsuccessful. Seventeen percent of the children over 1 year had been given beer.

One-third of those over 12 months of age were reported to eat dirt. This habit disappeared shortly after the age of 2.

Fifteen percent of the children over 1 year had been known to have passed *Ascaris*. Approximately 43 percent of the infants had had at least one attack of diarrhea, and several had experienced repeated episodes.



**Diet inquiry at Tessemet during the nutrition survey in Ethiopia**

Thirty-three percent of the children over 6 months of age had had the roots of the lower cuspid teeth needled and 39 percent had had the uvula amputated. These practices were even more common in rural areas and are part of traditional folk medicine.

Of the complaints for which children were brought to the clinic, one-quarter were recorded as gastrointestinal and respiratory disturbances. The next most common reasons for consulting a physician were to obtain vaccination or because of malnutrition.

**Table 1. Median capillary blood values, Ethiopian infants and children**

Blood analysis	Addis Ababa children, 0-5 years		Other Ethiopian children		Total	Range of 10-90 percentile	Number of samples	Range of number of samples per group
	Breast fed	Artificially fed	Pre-school <sup>1</sup>	6-17 years				
Packed cell volume.....	38.1	40.8	40.5	43.0	40.0	32-46	150	18-63
Ascorbic acid (mg./100 ml.).....	.12	.09	.06	.07	.08	0.00-0.65	113	13-44
Alkaline phosphatase (nitrophenol units).....	6.6	6.3	6.7	5.8	6.5	4-11	101	17-35
Total serum proteins (gm./100 ml.).....	6.75	6.70	7.60	7.4	7.1	5.8-8.7	78	12-30
Albumin (gm./100 ml.).....	3.1	3.1	3.3	3.5	3.2	2.4-3.8	74	11-28
Alpha-1 globulin (gm./100 ml.).....	.45	.45	.52	.54	.49	0.33-0.69	74	11-28
Alpha-2 globulin (gm./100 ml.).....	1.20	1.19	1.22	.96	1.16	0.66-1.57	74	11-28
Beta globulin (gm./100 ml.).....	.96	.95	1.17	1.05	1.04	0.75-1.60	74	11-28
Gamma globulin (gm./100 ml.).....	.90	.85	1.45	1.87	1.30	0.65-2.05	74	11-26

<sup>1</sup> Food practices unknown.

## Biochemical Findings

Capillary blood samples were collected from these children and analyzed at the Naval Medical Research Unit No. 3 in Cairo. The microchemical methods used for determination of ascorbic acid and alkaline phosphatase were those of Bessey (2). Total serum protein determinations were made by a standard biuret method. Electrophoresis was carried out on S and S 2043A paper strips and stained according to the method of Block and co-workers (3). The strips were scanned in a Beckman DU spectrophotometer at 575 millimicrons. Results are reported in absolute amounts derived by multiplying the total serum protein by the percentage of the various components. One or more determinations were completed on 100 of the 133 children. In addition, similar capillary blood samples were drawn from 39 infants or preschool children and from 19 school-age children examined during the survey and analyzed by the Navy unit.

The biochemical data obtained from the 133 children whose dietary histories were taken appeared to be similar for the four locations and are combined for presentation. They are subdivided into those children who were breast fed at the time that the sample was taken and those not breast fed. For analysis, the preschool children seen outside of Addis Ababa and the school-age children, 6 to 17 years, are considered separately.

**Table 2. Distribution frequency in percent of some biochemical findings among Ethiopian children**

Blood analysis	Addis Ababa children, 0-5 years		Other Ethiopian children	
	Breast fed	Artificially fed	Pre-school <sup>1</sup>	6-17 years
Albumin (<3.0 gm./100 ml.)	46	48	25	23
Gamma globulin (>1.2 gm./100 ml.)	0	33	79	100
Alkaline phosphatase (>10 units)	26	23	11	6
Ascorbic acid (<0.1 mg./100 ml.)	48	57	90	77

<sup>1</sup> Feeding practices unknown.

**Table 3. Average weight of 725 infants, birth through 18 months of age**

Age (months)	Number of weighings <sup>1</sup>	Weight (grams)
0	80	3,290
1	137	3,795
2	125	4,493
3	122	5,140
4	110	5,501
5	114	6,119
6	156	6,281
7	107	6,415
8	108	6,798
9	115	6,931
10	106	7,169
11	82	6,947
12	154	7,374
13	77	7,324
14	80	7,633
15	76	7,726
16	59	8,165
17	41	8,185
18	57	8,148

<sup>1</sup> 1,906 weighings of 725 infants of both sexes.

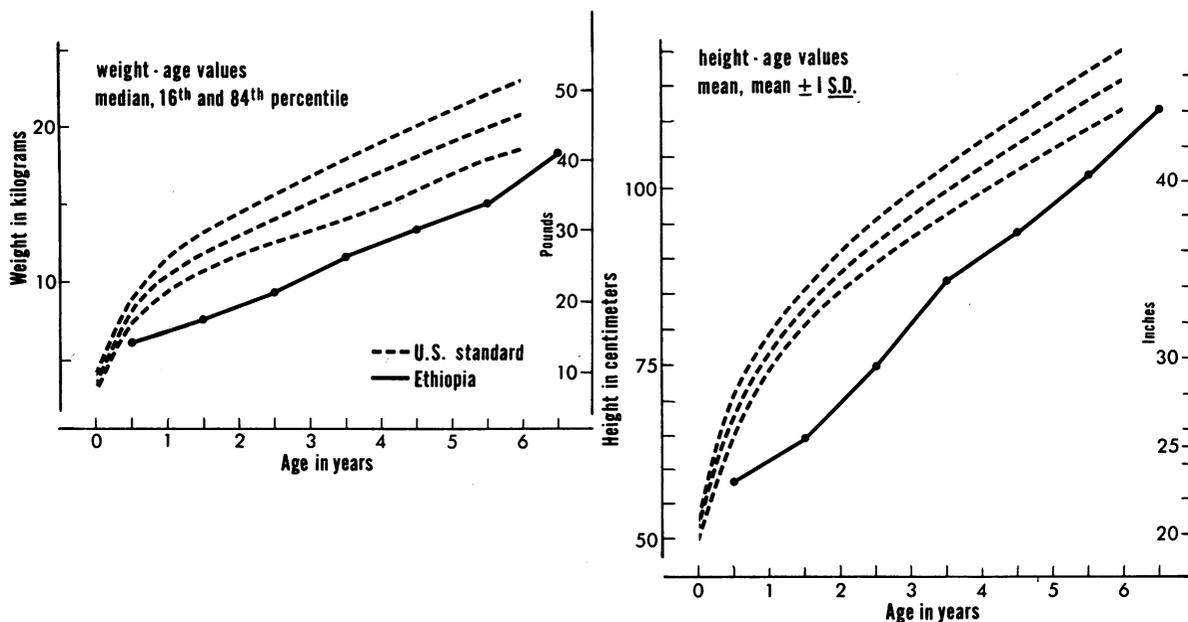
SOURCE: Unpublished data of Otto A. Jäger, M.D., school of public health, Gondar, Ethiopia.

Results of the determinations are given in tables 1 and 2. The packed blood cell volume was below 30 percent in 4 percent of the infants seen in the clinics and in none of the infants and preschool children examined outside of Addis Ababa. Packed cell volumes were slightly lower in the breast-fed infants than in the artificially fed infants under 2 years of age. This may reflect the high iron content of the cereals eaten. Two of the school-age children had packed cell volumes of less than 36 percent.

The ascorbic acid concentration in the serum was less than 0.1 mg. per 100 ml. in 53 percent of the children on whom dietary histories were obtained. There were no meaningful differences between breast-fed and artificially fed children. Only 6 of 113 infants had ascorbic acid concentrations greater than 0.7 mg. per 100 ml. Among the preschool children examined elsewhere and among school children, 90 and 77 percent respectively had less than 0.1 mg. per 100 ml. of ascorbic acid in their serum.

The serum alkaline phosphatase activity was elevated above a high normal level of 10 nitrophenol units per liter in 23 and 26 percent of the artificially fed and breast-fed infants respectively. Among the preschool children ex-

## Average height and weight of Ethiopian boys 0 to 6 years of age compared with U.S. standards



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amed as part of the regular survey, only 11 percent had elevated values and only one of the school children had a high value. Two of the preschool children had values above 30 nitrophenol units per liter, indicative of highly abnormal activity.

The total serum protein was determined on 78 infants and children. No differences were found between those breast fed and artificially fed. The serum albumin as determined electrophoretically was less than 3.0 gm. per 100 ml., a definitely subnormal value, in approximately one-half of the infants and one-quarter of the preschool and school children.

The alpha-1 globulin levels were within limits accepted as normal according to current American standards (4), while the alpha-2 and beta globulin values were elevated. In the breast-fed infants the median gamma globulin was 0.9 gm. per 100 ml. with little variability. Among the artificially-fed infants the median value was almost the same, but there were more values above 1.2 gm. per 100 ml. The median gamma globulin value for the preschool infants outside of Addis Ababa was 1.4 grams percent. For the school children the median value was 1.8 grams percent, with all of the values falling above 1.2 grams percent. The variation in the total serum protein among these groups was in

large part due to the variation in gamma globulin levels.

### Growth Patterns

The growth of Ethiopian infants has been documented by Dr. Otto Jäger of the public health school at Gondar. He tabulated weights of infants between birth and 18 months of age (table 3). These infants appear to have relatively satisfactory growth rates until the age of 5 or 6 months, at which time the gain in weight becomes very slow.

Data obtained during the nutrition survey extended these observations and demonstrated that growth failure persisted throughout the growth period (see chart). The chart shows the height and weight of Ethiopian boys compared with children in the United States. The Iowa growth curves were used as an arbitrary standard since suitable growth curves for Ethiopia were not available. Ethiopian children cared for by Swedish parents grew in keeping with European growth standards (personal communication, Dr. Edgar Maanheimer of the Ethiopian-Swedish Pediatric Clinic).

### Clinical Findings

Discussion with physicians interested in children in Addis Ababa and elsewhere in Ethiopia

resulted in a rather widely agreed-upon estimate that the incidence of rickets is about 30 percent at the age of 1 year. Rickets appears to be mild in its clinical manifestations in almost all the areas visited, since permanent rachitic deformities were rare. Rickets disappear after the age of 2 to 3 years. Usually, young infants do not receive either vitamin D supplementation or adequate exposure to sunlight until after they learn to walk and to fare for themselves. The available data on the serum alkaline phosphatase levels are compatible with this hypothesis.

Protein malnutrition was seen frequently in all the pediatric clinics visited, although the manifestations of red hair and severe dermatosis were rare. There appeared to be a higher incidence of protein malnutrition among the hospital population in Asmara than in Addis Ababa. In Asmara the survey team observed four instances of protein malnutrition in the pediatric ward on one visit and eight on another. The frequency with which children with protein malnutrition are brought for specific medical attention probably does not represent the true incidence of the condition, particularly since low serum albumin levels were found in half of the infants tested and growth retardation in the preschool group was very

common. Abnormally low serum albumin concentrations were found among the school children also.

Inquiries concerning other deficiency diseases in childhood were made. Occasional cases of scurvy were reported in Addis Ababa. None was seen during this survey. No clear instance of avitaminoses of the B-complex had been recognized, and anemia is relatively uncommon except as associated with malaria or hookworm infestations in some of the lowland areas. Neither of these diseases was found with any great frequency among the populations from which the preschool children were drawn.

The incidence of diarrhea in the infant population was difficult to assess except that it made up 40 to 50 percent of the hospital admissions in the preschool age group and accounted for a high percentage of the clinic visits. The association of recurrent bouts of diarrhea with protein malnutrition has been noted wherever protein malnutrition exists, and it is suggested that a similar association occurs in Ethiopia.

In the course of the survey 432 children less than 5 years of age were given an abbreviated clinical examination, and on 53 of these detailed physical examinations were done. The findings have been presented in table 4. By comparison with the total population group (1,5) there

**Table 4. Comparison of clinical findings in examinations of infants and preschool children with findings in total survey sample over 15 years, by percent**

Clinical findings	0-4 years		5-14 years		Over 15 years	
	Male N=221	Female N=211	Male N=1,371	Female N=697	Male N=2,497	Female N=813
Glands: Thyroid enlarged.....	0.5	0.0	2.5	5.1	2.4	12.2
Skin, face, and neck: Nasolabial seborrhea.....	.0	.0	.1	.1	22.5	9.8
Eyes: Bitot's spots.....	.0	.0	2.6	.1	1.5	.6
Lips:						
Angular lesions.....	1.4	3.3	1.2	.1	.5	.5
Angular scars.....	2.3	1.4	5.1	6.1	6.6	8.4
Cheilosis.....	2.7	4.3	4.9	5.2	4.0	3.9
Tongue: Filiform papillary atrophy, moderate or severe.....	.9	.5	4.1	.1	1.3	2.5
Gums:						
Marginal redness or swelling <sup>1</sup> .....	11.5	14.8	52.6	36.7	50.5	45.8
"Scorbutic-type" gums.....	.5	.9	1.3	.1	1.0	.7
Skin, general: Follicular hyperkeratosis.....	1.8	2.8	11.6	5.2	4.4	2.5
Lower extremities:						
Bilateral edema.....	1.8	.5	.1	2.2	1.4	5.7
Loss of ankle jerk.....	.9	1.4	2.2	1.4	3.9	3.9
Calf tenderness, moderate or severe.....	.0	.0	.1	.1	.3	.6

<sup>1</sup> These data obtained from detailed examinations.

were several differences which may be attributable to age.

There was a low incidence of thyroid enlargement among these children, only one instance being recorded. Nasolabial seborrhea was not noted in this age group. Bitot's spots were not seen. The relatively high incidence of conjunctival injection was due to conjunctivitis. The incidence of follicular hyperkeratosis was lower in this age group than in older children, particularly for the boys.

Lesions at the angles of the lips were more common in this age group than in any other, with an incidence of 3.3 percent in the girls. Edema was not as frequent a finding in these young children as had been expected on the basis of the serum albumin levels.

The other clinical observations have an incidence pattern that does not appear to differ significantly from the rest of the Ethiopian population observed. No scurvy, beriberi, pellagra, or xerophthalmia was observed.

### Summary and Conclusions

The dietary histories are representative of infants living in cities who attended clinics, and cannot be considered representative for the country as a whole. The food practices reflect a degree of sophistication beyond that to be expected generally. The feeding pattern consisted of breast feeding for periods of 18 months or longer for almost half the infants. Supplements of cow's milk were given to more than 80 percent of the children at some time during the first year of life and somewhat less frequently thereafter. Supplementary foods used were mainly injera, bread, and tea. By the age of 2 years the child usually ate the adult diet, but in some instances still received only milk.

The laboratory assessment of the nutritive status of this group of preschool and school children warrants several conclusions. Anemia was relatively uncommon. The intake of ascorbic acid resulted in high blood levels of vitamin C in only 5 percent of the group and deficient levels in 65 percent. The alkaline phosphatase activity was elevated in 11 to 26 percent of the preschool children but in only one school child. The serum proteins showed greater variability than would be expected in healthy individuals, with an excess of both low

and high values. The serum albumin level was abnormally low in one-half of the infants and one-quarter of the preschool and school children. The alpha-2 and beta globulin values were almost universally elevated, and the gamma globulin was elevated in all but the breast-fed infants examined in Addis Ababa. It is suggested that the increase in gamma globulin levels may result from the increased number of contacts with infectious or parasitic disease, which seems more likely to occur in artificially fed infants. From the laboratory assessment it appears that there are widespread low intakes of ascorbic acid, that the clinical evidence of common mild rickets is supported, and that the hypoalbuminemia and hyperglobulinemia may reflect environmental influences, including nutrition. There is little nutritional anemia among these infants and preschool children.

The growth observations are similar to those reported from other areas of the world where protein malnutrition is common, where preclinical kwashiorker exists, and infant- and child-feeding practices are similarly unsatisfactory.

The most common nutritional diseases seen in infancy were rickets and protein malnutrition. The association of edema, marasmus, and diarrhea was encountered frequently. Growth failure was almost universal in the preschool children, although incidence of specific nutritional disease in this age group was low in those brought for examination.

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